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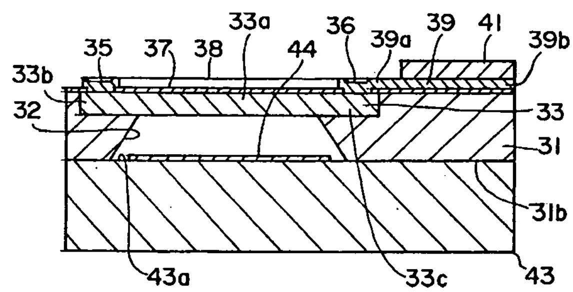
(54)【発明の名称】　赤外線放射素子

(57)【要約】
【課題】　素子単品で回路に実装でき、低コスト化を実現する。
【解決手段】　赤外線放射素子３０は、一面側から反対面に貫通する穴３２を有する素子基板３１と、素子基板３１の一面側に形成され、穴３２の開口面を横切る橋梁状の発熱部３３ａを有し、通電により発熱部３３ａから赤外線を放射させるｐ型半導体層３３と、発熱部３３ａに通電するためにｐ型半導体層３３上に形成された一対の電極３５、３６と、素子基板３１の一面側の端部に形成され、一対の電極３５、３６にそれぞれ接続された電力供給用の一対の端子４０、４１と、素子補強のために素子基板の反対面に固定された補強基板４３とを備えており、補強基板４３によって素子全体が補強され、且つ、端子４０、４１が素子基板３１の一面側の端部に形成されているので、素子単品で回路や装置に簡単に組み込むことができる。



【特許請求の範囲】

【請求項１】一面側から反対面に貫通する穴または一面側から反対面側へ陥没する陥没部を有する素子基板と、

前記素子基板の前記一面側に形成され、前記穴または陥没部の開口面を横切る橋梁状の発熱部を有し、通電により前記発熱部から赤外線を放射させる半導体層と、

前記発熱部に通電するために前記半導体層上に形成された一対の電極と、

前記素子基板の前記一面側に端部に形成され、前記一対の電極にそれぞれ接続された電力供給用の一対の端子と、

素子補強のために前記素子基板の前記反対面に固定された補強基板とを備えた赤外線放射素子。

【請求項２】前記素子基板の前記一面側で前記発熱部を囲むように形成された絶縁性を有する枠状体と、

赤外線透過性を有し、前記枠状体の開口面を覆うように形成された絶縁性を有するカバーとを備えたことを特徴とする請求項１記載の赤外線放射素子。

【請求項３】前記補強基板の一面側の少なくとも前記素子基板の前記穴を塞いでいる部分または前記素子基板の陥没部の底が赤外線に対して高い反射率を示すように形成されていることを特徴とする請求項１または請求項２記載の赤外線放射素子。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、シリコン等の素子基板上に半導体で形成した発熱部から赤外線を放射する赤外線放射素子において、構造を簡単化し生産性を高めコストを下げるための技術に関する。

【０００２】

【従来の技術】赤外線放射素子は、発光素子としての利用の他に、赤外線の吸収を利用したガス分析機器の光源としても利用されている。

【０００３】この赤外線式ガス分析のために従来から用いられていた赤外線光源は、セラミックにヒータを埋め込んだものや、白金やタングステンのフィラメントをガラス管に封入したものであったが、いずれの構造のものも経時変化が大きいという問題があり、また、熱容量が大きいために間欠的に赤外線を放射させる（チョッピング）場合に、高速な機械的なチョッパーが別途必要であった。

【０００４】この問題を解決するために、マイクロマシニング技術を用いてシリコン等の素子基板の一面に半導体からなる発熱部を設け、この発熱部に通電をして赤外線を放射する、いわゆるマイクロブリッジ構造の赤外線放射素子が種々提案されている。

【０００５】このマイクロブリッジ構造の赤外線放射素子としては、図２１、図２２に示す構造のものが知られている。

【０００６】この赤外線放射素子１０は、マイクロマシニング技術によって、シリコンの素子基板１１の一面１１ａ側に陥没部１２を設け、この陥没部１２の開口面を横切るようにｐ型半導体からなる発熱部１３を設け、発熱部１３の両端に電極１４、１５を設けている。

【０００７】この赤外線放射素子１０では、電極１４、１５間に電圧を印加すると発熱部１３が発熱し、赤外線が放射される。

【０００８】このようなマイクロブリッジ構造の赤外線放射素子１０は、素子形状が小さく熱容量が小さいため、高速なチョッピングができるという利点がある。

【０００９】ただし、シリコンの素子基板上１１に形成された赤外線放射素子１０を、このままの形で各種装置に実装するのは不便なので、実際には、図２３に示すように、赤外線放射素子１０をケース基板２０上にマウントし、ケース基板２０を貫通するように固定されたリード端子２１、２２の上端と赤外線放射素子１０の電極１４、１５の間を金ワイヤー２３、２４でそれぞれ接続（ボンディング）してから、円筒ケース２５を被せて赤外線放射素子１０を保護するとともに電源の供給を端子２１、２２から行えるようにしている。

【００１０】なお、円筒ケース２５の上面は、赤外線に対して透過率が高い材質（例えばサファイア）からなる窓２６によって覆われており、赤外線放射素子１０から放射された赤外線は、この窓２６から外部へ放射される。

【００１１】

【発明が解決しようとする課題】しかしながら、前記したように、赤外線放射素子１０をケース基板２０にマウントし、その電極１４、１５とリード端子２１、２２との間の配線を行い、円筒ケース２５を被せて完成する赤外線放射器は、素子自体の製造工程の他に、マウント、ボンディング、ケース固定等の工程を含み、部品点数が多くなるので、コスト高になるという問題があった。

【００１２】本発明は、この問題を解決し、素子単品で回路に実装でき、低コスト化を実現した赤外線放射素子を提供することを目的としている。

【００１３】

【課題を解決するための手段】前記目的を達成するために、本発明の請求項１の赤外線放射素子は、一面側から反対面に貫通する穴または一面側から反対面側へ陥没する陥没部を有する素子基板と、前記素子基板の前記一面側に形成され、前記穴または陥没部の開口面を横切る橋梁状の発熱部を有し、通電により前記発熱部から赤外線を放射させる半導体層と、前記発熱部に通電するために前記半導体層上に形成された一対の電極と、前記素子基板の前記一面側に端部に形成され、前記一対の電極にそれぞれ接続された電力供給用の一対の端子と、素子補強のために前記素子基板の前記反対面に固定された補強基板とを備えている。

【００１４】また、本発明の請求項２の赤外線放射素子

は、請求項１の赤外線放射素子において、前記素子基板の前記一面側で前記発熱部を囲むように形成された絶縁性を有する枠状体と、赤外線透過性を有し、前記枠状体の開口面を覆うように形成された絶縁性を有するカバーとを備えている。

【００１５】また、本発明の請求項３の赤外線放射素子は、請求項１または請求項２の赤外線放射素子において、前記補強基板の一面側の少なくとも前記素子基板の前記穴を塞いでいる部分または前記素子基板の陥没部の底が赤外線に対して高い反射率を示すように形成されている。

【００１６】

【発明の実施の形態】以下、図面に基づいて本発明の実施形態を説明する。なお、以下の各実施形態の説明において、同一構成要素には同一符号を付して説明を省略する。

【００１７】図１、図２は、本発明の第１の実施形態の赤外線放射素子３０を示している。この赤外線放射素子３０の素子基板２１は、例えばｎ型シリコンで２５ｍｍ×１０ｍｍ程度の横長矩形状に形成され、その一端側には一面３１ａ側から反対面３１ｂ側に台形状に貫通する穴３２が設けられている。

【００１８】素子基板３１の一面３１ａ側にはｐ型半導体層３３が略ｈ状に形成されている。ｐ型半導体層３３には、素子基板３１の一面３１ａ側において穴３２の開口面の中央を横切るように形成された発熱部３３ａが設けられている。ｐ型半導体層３３の両端３３ｂ、３３ｃの表面には、金属材（金やアルミニウム等）からなる一対の電極３５、３６が設けられている。

【００１９】ｐ型半導体層３３の両端３３ｂ、３３ｃは、幅広で抵抗値が低くしかも素子基板３１に接しているのに対し、発熱部３３ａは幅狭で抵抗値が高く素子基板３１から離れているので、電極３５、３６間に電圧を印加してｐ型半導体層３３に電流を流した場合、発熱部３３ａだけが発熱し、赤外線を放射する。

【００２０】素子基板３１の一面３１ａおよび電極３５、３６とｐ型半導体層３３の接合部分を除く表面は、絶縁性を有し且つ赤外線の放射を促進するためのシリコン酸化膜３７（図１では省略している）によって覆われている。

【００２１】即ち、酸化膜の厚さは単に表面保護のためだけの場合０．１μｍ程度で十分であるが、図３に示すように、シリコン酸化膜の厚さを一定値（ほぼ１μｍ）以上にすると赤外線の放射率が格段に高くなることが判明したので、この実施形態の赤外線放射素子３０では、少なくとも発熱部３３の表面のシリコン酸化膜３７の厚さを０．４μｍ以上（例えば１μｍ程度）に設定して、表面の保護を強化し赤外線の放射効率を向上させている。

【００２２】シリコン酸化膜３７の表面には、金属材（金やアルミニウム等）からなる接続パターン３８、３９が形成されている。一方の接続パターン３８は、その一端３８ａ側が電極３５に接続され、他端３８ｂ側が素子基板３１の他端側まで延びている。

【００２３】他方の接続パターン３９は、その一端３９ａが電極３６に接続され、他端３９ｂが素子基板３１の他端側まで延びている。

【００２４】接続パターン３８、３９の他端３８ｂ、３９ｂの上面には、電力供給用の端子４０、４１が半田等によって形成されている。

【００２５】端子４０、４１は、所定の隙間をもって平行に素子基板３１の短辺側エッジまで延びている。端子４０、４１の端子間隔は、例えば１／１０インチピッチのコネクタに装着できるように、約５．１ｍｍ（２／１０インチ）や約７．６ｍｍ（３／１０インチ）に設定されている。

【００２６】一方、素子基板３１の反対面３１ｂ側には、素子補強のために素子基板３１と同一外形の絶縁性を有する補強基板４３が固定されている。この補強基板４３は、例えばアルミナやサファイアのように熱伝導がよい材質からなり、赤外線放射素子３０全体の厚みを素子単品で扱うことが容易な０．５ｍｍ～１ｍｍ程度にするために、２００μｍ～５００μｍの厚さを有している。

【００２７】補強基板４３の上面４３ａのうち、素子基板３１の穴３２の底を形成する部分には、赤外線に対して高い反射率を有する反射膜４４（例えば金薄膜やアルミ箔等）が設けられている。発熱部３３ａから補強基板４３側へ放射された赤外線は、この反射膜４４によって素子基板３１の一面側へ反射するので、赤外線の放射効率が高くなる。

【００２８】この赤外線放射素子３０は、マイクロマシニング技術によって容易に製造することができる。以下、その製造方法を簡単に説明する。なお、以下の説明では一つの赤外線放射素子３０について説明するが、実際には、大きな素子基板上に複数個の赤外線放射素子３０を同時に形成する。

【００２９】先ず、比抵抗８～１５Ω・ｃｍの面方位（１００）のn^-型単結晶半導体の基板を素子基板の母材として用意し（以下、この母材を素子基板３１という）、その素子基板３１の一面に熱酸化処理を施すことによって０．７μｍ程度の厚さの熱酸化膜を形成し、ｐ型半導体層３３を形成する領域の熱酸化膜を写真蝕刻技術によって除去する。

【００３０】次に、素子基板３１の一面に対してイオン注入法を用いて、高濃度、例えばドーズ量として４．０×10^{16}イオン／cm^2のボロンを加速電圧１７５ｋＶで打ち込み、１１００～１２００度Ｃの高温の窒素ガス雰囲気中で１０分から６０分程度のアニーリングを施して、前記酸化膜が除去された領域に所望の厚さ（例えば

5μm）のp型半導体層３３を形成してから、素子基板３１の表面の熱酸化膜を除去する。

【００３１】次に、素子基板３１の一面側に熱酸化処理によって０．４μm～１μm程度の厚さで熱酸化膜３７（この酸化膜３７は、素子表面の保護と赤外線の放射促進用である）を形成し、p型半導体層３３の両端の電極形成領域の熱酸化膜を写真蝕刻技術によって除去してから、素子基板３１の一面側全体に金、アルミニウム等の薄膜を真空蒸着法によって形成した後、パターニングによって電極形成領域および接続パターン形成領域以外の薄膜を除去して、電極３５、３６および接続パターン３８、３９を形成する。

【００３２】次に、アンモニア溶液等の異方性エッチング特性と、エッチング速度のキャリア濃度依存性を利用して発熱部３３ａの下面側から素子基板３１の反対面側へ貫通する穴３２を形成する。

【００３３】次に、真空中で補強基板４３の一面４３ａを素子基板３１の反対面に重ねた状態で、電極３５または電極３６と補強基板４３の反対面４３ｂとの間に高電圧（５００V程度）を印加して素子全体を２００～３００度Cに加熱し、補強基板４３の一面４３ａを素子基板３１の反対面に融着させる。

【００３４】そして、接続パターン３８、３９の他端３８ｂ、３９ｂの上面に半田を蒸着して端子４０、４１を形成する。

【００３５】最後に、ダイサーで素子基板をチップ単位に分割することで、前記した赤外線放射素子３０の単品が得られる。

【００３６】上記のように構成された赤外線放射素子３０は、補強基板４３によって素子全体が補強されており、且つ、素子基板３１の一面側のエッジに端子４０、４１が形成されているので、素子単品で回路や装置に簡単に組み込むことができる。

【００３７】例えば、図４に示すように、回路基板４５上に実装されたコネクタ４６に赤外線放射素子３０を装着することができる。

【００３８】また、コネクタを用いずに、図５のように、回路基板４５上に赤外線放射素子３０の端子４０、４１を直接半田付けすることもできる。

【００３９】また、回路基板上に直接装着せずに、図６に示すように、リード線４７を赤外線放射素子３０の端子４０、４１に半田付けして利用することも可能である。

【００４０】このように、実施形態の赤外線放射素子３０は、従来素子のようにケースにマウントする必要がなく、素子単品で使用することができるので、製造コストを大幅に削減することができ、製品コストを大幅に下げることができる。

【００４１】また、この赤外線放射素子３０では、電源供給用の端子４０、４１を発熱部３３ａの一端側に発熱部３３ａと平行に設けていたが、これは本発明を限定するものでない。例えば図７、図８の赤外線放射素子５０のように、p型半導体層３３をH状（あるいはU字状）に形成し、その両端に電極３５、３６を設け、電極３５、３６から発熱部３３ａに直交する向きに延びた接続パターン３８、３９の先端側に電源供給用の端子４０、４１を設けてもよい。なお、この場合でも、コネクタに対する装着を考慮して端子４０、４１の間隔を設定する。

【００４２】また、前記赤外線放射素子３０、５０では、発熱部３３ａの表面をシリコン酸化膜３７だけで保護していたが、図９、図１０に示す赤外線放射素子６０のように、サファイヤ等で表面を覆うようにしてもよい。

【００４３】この赤外線放射素子６０の素子基板６１は、n⁻型シリコンで例えば４０mm×１５mm程度の横長矩形状に形成され、その一端側には一面６１ａ側から反対面６１ｂ側に台形状に貫通する穴６２が設けられている。

【００４４】素子基板６１の一面６１ａ側にはp型半導体層６３が横向きU字状に形成されている。p型半導体層６３には、素子基板６１の一面６１ａ側において穴６２の開口面の中央を横切る発熱部６３ａと、発熱部３３ａの先端（図９で左端）から穴６２の周縁に沿って素子基板６１の他端側に戻るように形成された折り返し部６３ｂとが設けられている。この折り返し部６３ｂの幅は、通電による大きな発熱が生じないように、発熱部６３ａより大きく設定されている。

【００４５】p型半導体層６３の両端表面には、金属材からなる一対の電極６５、６６が設けられており、電極６５、６６の間に電圧を印加すると、発熱部６３ａが発熱し、赤外線を放射する。

【００４６】電極６５、６６から素子基板６１の他端側エッジまでの表面は、シリコン酸化膜６７によって覆われている。

【００４７】このシリコン酸化膜６７の表面には、金属材からなる接続パターン６８、６９が形成されている。一方の接続パターン６８は、その一端側が電極６５に接続され、他端側が素子基板６１の他端側まで延びている。

【００４８】他方の接続パターン６９は、その一端が電極６６に接続され、他端が素子基板６１の他端側まで延びている。

【００４９】接続パターン６８、６９の他端の上面には、電力供給用の端子７０、７１が形成されている。端子７０、７１は、所定の隙間をもって平行に素子基板６１の一端側のエッジまで延びている。端子７０、７１の端子間隔は、前記同様に１／１０インチピッチのコネクタに装着できるように、約５．１mm（２／１０インチ）や約７．６mm（３／１０インチ）等に設定されて

いる。
【0050】素子基板６１の他端側上面には、シリコンや硝子等で矩形枠状に形成された枠状体７３が、発熱部６３ａを囲むように固定されている。
【0051】枠状体７３の開口された上面側は、赤外線に対する透過率が高いサファイヤや硝子等で平板状に形成されたカバー７４によって覆われている。
【0052】一方、素子基板６１の反対面６１ｂ側には、素子補強のために素子基板６１と同一外形の絶縁性を有する補強基板７５が固定されている。この補強基板７５は、例えばアルミナやサファイアのように熱伝導がよい材質で２００μｍ～５００μｍの厚さを有している。この補強基板７５の上面７５ａのうち、素子基板６１の穴６２の底を形成する部分には、赤外線に対して高い反射率を有する反射膜７６（例えば金薄膜やアルミ箔等）が設けられている。
【0053】この赤外線放射素子６０もマイクロマシニング技術によって容易に製造することができる。以下、その製造方法を簡単に説明する。なお、以下の説明では一つの赤外線放射素子６０について説明するが、実際には、大きな素子基板上に複数個の赤外線放射素子６０を同時に形成する。
【0054】先ず、比抵抗８～１５Ω・ｃｍの面方位（１００）のｎ－型単結晶半導体を素子基板６１として用意し、その素子基板５１の一面に熱酸化処理を施すことによって０．７μｍ程度の厚さの熱酸化膜を形成し、ｐ型半導体層を形成する領域の熱酸化膜を写真蝕刻技術によって除去する。
【0055】次に、素子基板６１の一面に対してイオン注入法を用いて、高濃度、例えばドーズ量として４．０×10^{16}イオン／ｃm^2のボロンを加速電圧１７５ｋＶで打ち込み、１１００～１２００度Ｃの高温の窒素ガス雰囲気中で１０分から６０分程度のアニーリングを施して、前記酸化膜が除去された領域に所望の厚さ（例えば５μｍ）のｐ型半導体層６３を形成してから、素子基板６１の表面の熱酸化膜を除去する。
【0056】次に、素子基板６１の一面側に熱酸化処理によって０．４μｍ～１μｍ程度の厚さでシリコン酸化膜６７を形成し、電極形成領域の熱酸化膜を写真蝕刻技術によって除去してから、素子基板６１の一面全体に金、アルミニウム等の薄膜を真空蒸着法によって形成した後、パターニングによって電極形成領域および接続パターン形成領域以外の薄膜を除去して、電極６５、６６および接続パターン６８、６９を形成する。
【0057】次に、アンモニア溶液等の異方性エッチング特性と、エッチング速度のキャリア濃度依存性を利用して発熱部６３ａの下面側から素子基板６１の反対面側へ貫通する穴６２を形成する。
【0058】次に、真空中で枠状体７３を素子基板６１上の所定位置に置き、その枠状体７３の上にカバー７４を重ね、さらに、補強基板７５の一面７５ａを素子基板６１の反対面に重ねた状態で、カバー７４と補強基板７５の反対面８５ｂとの間に高電圧を印加して素子全体を２００～３００度Ｃに加熱し、素子基板６１の一面側と枠状体７３の下面側の間、枠状体７３の上端面とカバー７４の下面との間および補強基板７５の一面７５ａと素子基板６１の反対面との間を融着する。
【0059】そして、最後に、接続パターン６８、６９の他端６８ｂ、６９ｂの上面に半田を蒸着して端子７０、７１を形成する。
【0060】このようにして作製された赤外線放射素子はダイサーでチップ単位に分割されて、単品となる。
【0061】この赤外線放射素子６０では、補強基板７５によって素子全体が補強されており、且つ、素子基板６１の一面側のエッジに端子７０、７１が形成されているので、前記した図４～図６のように、コネクタ装着、直付け、リード線による配線が可能となり、素子単品で回路や装置に簡単に組み込むことができる。
【0062】また、この赤外線放射素子６０は、発熱部６３ａの表面側がカバー７４によって覆われているので、発熱部６３ａの表面の汚れ等による劣化が少なく信頼性が高い。
【0063】このように、実施形態の赤外線放射素子６０は、従来素子のようにケースにマウントする必要がなく、素子単品で使用することができるので、製造コストを大幅に削減することができ、高い信頼性を維持しながら大幅なコストダウンが可能となる。
【0064】なお、上記赤外線放射素子３０、５０、６０では、発熱部３３ａ、６３ａから補強基板４３、７５側に放射された赤外線を反射膜４４、７６によって素子基板３１、６１の一面側へ反射しているが、補強基板４３、７５自体が赤外線に対して高い反射率を有する場合には、反射膜４４、７６を省略することができる。
【0065】また、図１１の（ａ）およびそのＥ－Ｅ線断面図の（ｂ）に示すように、補強基板４３（７５）の一面側に凹面部４８を形成したり（補強基板自体が赤外線に対して高い反射率を有する場合）、この凹面部４８に沿って反射膜４９を設ける（補強基板自体が赤外線に対して高い反射率を有していない場合）ことで、発熱部３３ａ（６３ａ）から補強基板４３（７５）側に放射された赤外線を凹面部４８または反射膜４９によって素子基板３１（６１）の一面側に直交する方向へ効率良く反射させることができる。
【0066】また、前記実施形態は、素子基板３１、６１に穴３２、６２が設けられている場合について説明したが、素子基板に陥没部が設けられている赤外線放射素子についても本発明を同様に適用できる。
【0067】例えば図１２、図１３に示す赤外線放射素子８０のように、素子基板３１′に陥没部８２が設けられ、ｐ型半導体層３３の発熱部３３ａが、素子基板３

１′の一面側において陥没部８２の開口面を横切るように形成されている場合でも、電極３５、３６を接続パターン３８、３９を介して端子４０、４１に接続し、素子基板３１′の下面側に補強基板４３を固定することにより、前記赤外線放射素子３０と同様の効果が得られる。

【００６８】また、例えば図１４、図１５に示す赤外線放射素子９０のように、素子基板６１′に陥没部９２が設けられ、ｐ型半導体層６３の発熱部６３ａが、素子基板６１′の一面側において陥没部９２の開口面を横切るように形成されている場合でも、電極６５、６６を接続パターン６８、６９を介して端子７０、７１に接続し、枠状体７３とカバー７４によって発熱部６３ａの一面側を覆うとともに、素子基板６１′の下面側に補強基板７５を固定することにより、前記赤外線放射素子６０と同様の効果が得られる。

【００６９】なお、前記赤外線放射素子６０および赤外線放射素子９０の枠状体７３とカバー７４とで覆われている部分には、熱伝導率が高いヘリウム、アルゴン等のガスを封入しておく。

【００７０】また、赤外線放射素子８０、９０のように、素子基板３１′、６１′の陥没部８２、９２の開口面を横切るように発熱部３３ａ、６３ａを設けた場合には、陥没部８２、９２の底面に赤外線に対して高い反射率を示す反射膜８４、９４を設けることにより、赤外線の放射効率が高くなる。

【００７１】また、この赤外線放射素子８０、９０の製造方法は、前記した赤外線放射素子３０、６０の製造方法において穴３２、６２をエッチング加工する代わりに陥没部８２、９２をエッチング加工する点が異なるが、その他は同じである。

【００７２】また、前記実施形態では、発熱部が１つの場合の赤外線放射素子について説明したが、発熱部を複数有する赤外線放射素子についても本発明を適用できる。

【００７３】例えば、図１６、図１７に示す赤外線放射素子１００のように、シリコン等の素子基板１０１に複数個（図では４個）の穴１０２ａ～１０２ｄを形成し、素子基板１０１の一面側に形成したｐ型半導体層１０３に各穴１０２ａ～１０２ｄの開口面を横切り且つ直列（並列でもよい）に接続された発熱部１０３ａ～１０３ｄを設け、ｐ型半導体層１０３の両端に形成した電極１０５、１０６と素子基板１０１の一面側のエッジに所定間隔で形成された電力供給用の端子１１０、１１１の間を接続パターン１０８、１０９を介して接続する。

【００７４】そして、素子基板１０１の反対面側に補強のための補強基板１１３を固定する。なお、図１６、図１７において符号１０７は各発熱部１０３を含む素子表面を保護し、また赤外線の放射を促進するシリコン酸化膜、符号１１４ａ～１１ｄは各発熱部１０３から補強基板１１３側へ放射される赤外線を素子基板１０１の一面側に高い反射率で反射する反射膜である。

【００７５】また、図１８、図１９に示す赤外線放射素子１２０のように、シリコン等の素子基板１２１に複数個（図では４個）の穴１２２ａ～１２２ｄを形成し、素子基板１２１の一面側に形成したｐ型半導体層１２３に各穴１２２ａ～１２２ｄの開口面を横切り且つ直列（並列でもよい）に接続された発熱部１２３ａ～１２３ｄを設け、ｐ型半導体層１２３の両端に形成した電極１２５、１２６を接続パターン１２８、１２９を介して素子基板１２１の一面側のエッジに所定間隔で形成された端子１３０、１３１に接続する。

【００７６】そして、枠状体１３３とその開口面を塞ぐカバー１３４とによって、各発熱部１２３ａ～１２３ｄの表面側を覆い、さらに、素子基板１２１の反対面側に補強のための補強基板１３５を固定する。なお、この赤外線放射素子１２０の場合も、前記赤外線放射素子６０、９０と同様に、枠状体１３３とカバー１３４とで覆われている部分に、熱伝導率が高いヘリウム、アルゴン等のガスを封入しておく。

【００７７】また、図１８、図１９において符号１２７はシリコン酸化膜、符号１３６ａ～１３６ｄは各発熱部１２３ａ～１２３ｄから補強基板１３５側へ放射される赤外線を素子基板１２１の一面側に高い反射率で反射する反射膜である。

【００７８】また、前記赤外線放射素子１００、１２０では、１つの穴について発熱部を１つずつ設けているが、１つの穴の開口面を複数の発熱部が横切るように形成してもよい。

【００７９】このように複数の発熱部を有する赤外線放射素子では素子１個当りの赤外線放射パワーを大きくすることができる。

【００８０】また、前記した各赤外線放射素子では、発熱部をｐ型半導体層によって形成していたが、発熱部を補強するために、図２０のように、素子基板３１の一面側にｐ型半導体で穴３２（または陥没部）の開口面を横切る橋梁支持部１５０を形成し、この橋梁支持部１５０の上にｎ型半導体で発熱部１５３を形成し，この発熱部１５３に図示しない電力供給用の端子から電力を供給して赤外線を放射させるようにしてもよい。このように、発熱部を橋梁支持部上に形成することで、発熱部の強度を増すことができ、単品での扱いがさらに容易となる。

【００８１】

【発明の効果】以上説明したように、本発明の請求項１の赤外線放射素子は、素子基板の一面側において半導体層で穴または陥没部を横切るように橋梁状に形成された発熱部の電極を、素子基板の一面側端部に形成された電力供給用の端子に接続するとともに、素子基板の反対面側に補強基板を固定している。

【００８２】このため、赤外線放射素子をあらためてケース内にマウントする工程が不要となり、素子単品でコ

ネクタに装着したり、回路基板上に直に半田付けしたり、リード線の配線で回路と接続することができ、製造コストを大幅に下げることができ、赤外線放射素子を安価に提供できる。

【００８３】また、本発明の請求項２の赤外線放射素子は、素子基板の一面側で発熱部を囲むように形成された絶縁性を有する枠状体と、赤外線透過性を有し、枠状体の開口面を覆うように形成された絶縁性を有するカバーとを備えている。

【００８４】このため、発熱部の表面が枠状体とカバーによって保護されるので、発熱部表面の汚れ等による劣化がなく信頼性が高くなる。

【００８５】また、本発明の請求項３の赤外線放射素子は、素子基板の穴を塞いでいる補強基板または素子基板の陥没部の底が、赤外線に対して高い反射率を示すように形成されているので、赤外線の放射効率が高くなる。

【図面の簡単な説明】

【図１】本発明の一実施形態の平面図

【図２】図１のＢ－Ｂ線断面図

【図３】酸化膜の厚さと赤外線放射率との関係を示す図

【図４】実施形態の赤外線放射素子の実装例を示す図

【図５】実施形態の赤外線放射素子の実装例を示す図

【図６】実施形態の赤外線放射素子の実装例を示す図

【図７】他の実施形態の平面図

【図８】図７のＣ－Ｃ線断面図

【図９】他の実施形態の平面図

【図１０】図９のＤ－Ｄ線断面図

【図１１】補強基板に凹面部を設けた場合の概略図

【図１２】他の実施形態の平面図

【図１３】図１２のＦ－Ｆ線断面図

【図１４】他の実施形態の平面図

【図１５】図１４のＧ－Ｇ線断面図

【図１６】他の実施形態の平面図

【図１７】図１６のＨ－Ｈ線断面図

【図１８】他の実施形態の平面図

【図１９】図１８のＩ－Ｉ線断面図

【図２０】発熱部を２層構造にした例を示す概略図

【図２１】従来素子の平面図

【図２２】図２２のＡ－Ａ線断面図

【図２３】従来素子の外装を示す図

【符号の説明】

３０、５０、６０、８０、９０　１００、１２０　赤外線放射素子

３１、６１、１０１、１２１　素子基板

３２、６２　穴

３３、６３、１０３、１２３　ｐ型半導体層

３３ａ、６３ａ、１０３ａ、１２３ａ　発熱部

３５、３６、６５、６６、１０５、１０６、１２５、１２６　電極

３８、３９、６８、６９、１０８、１０９、１２８、１２９　接続パターン

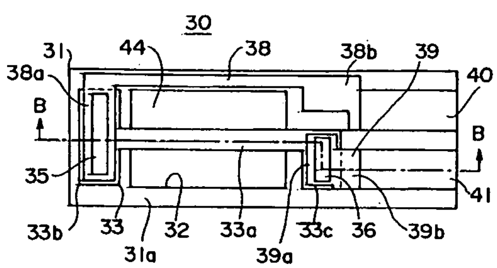
４０、４１、７０、７１、１１０、１１１、１３０、１３１　端子

４３、７５、１１３、１３５　補強基板

４４、７６、１１４、１３６　反射膜

８２、９２　陥没部

【図１】



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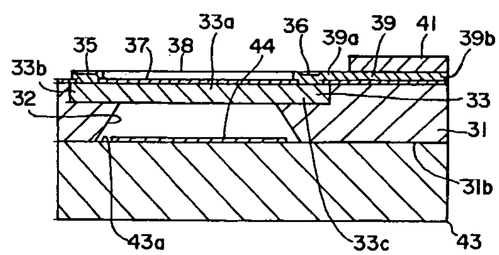

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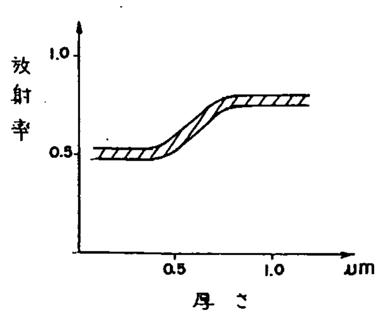

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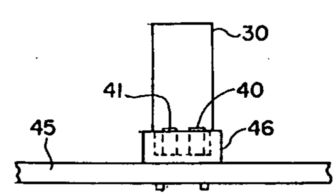

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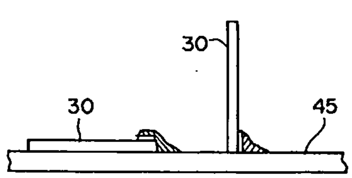

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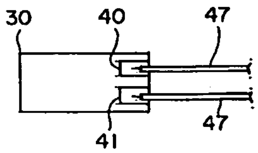

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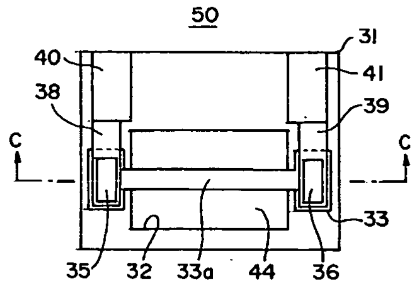

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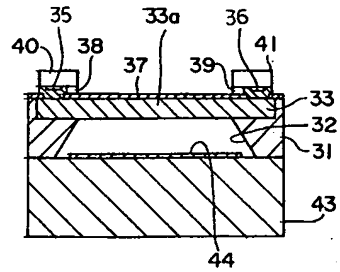

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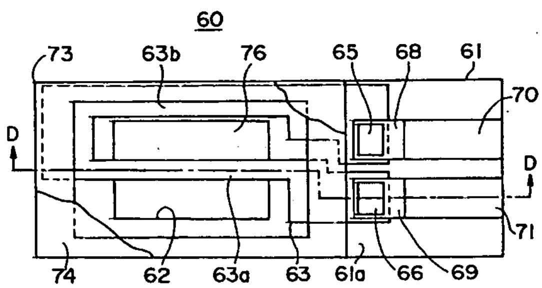

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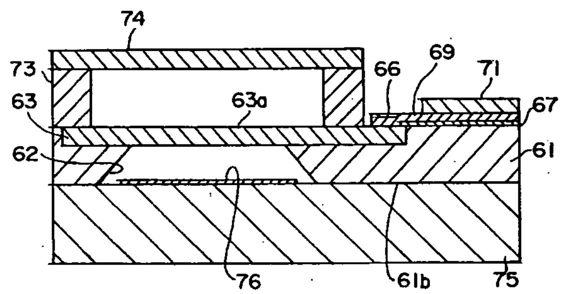

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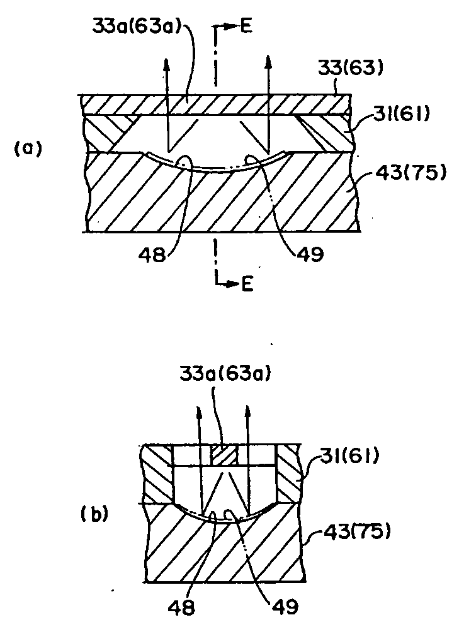

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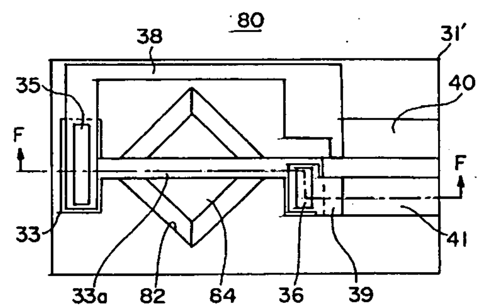

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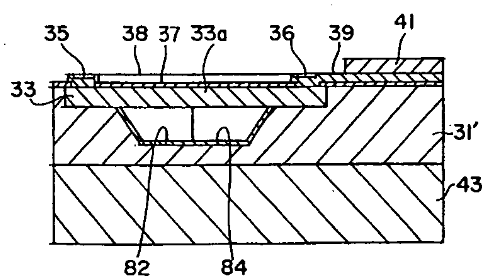

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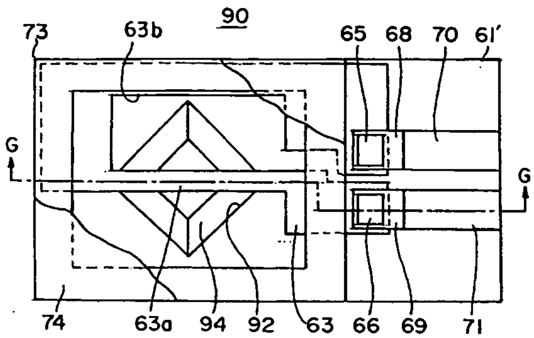

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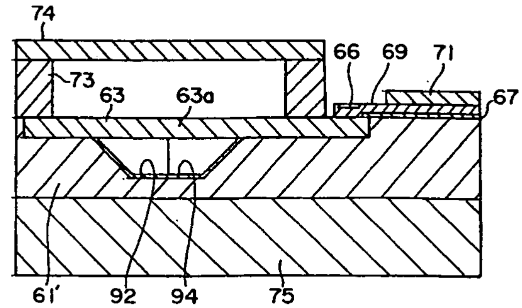

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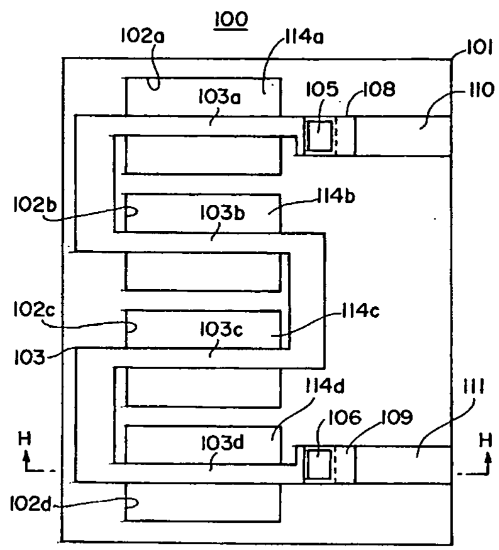

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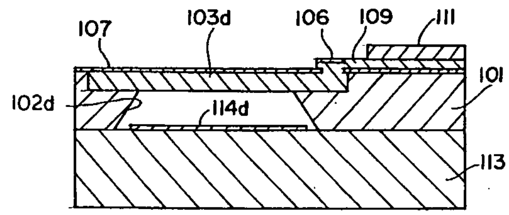

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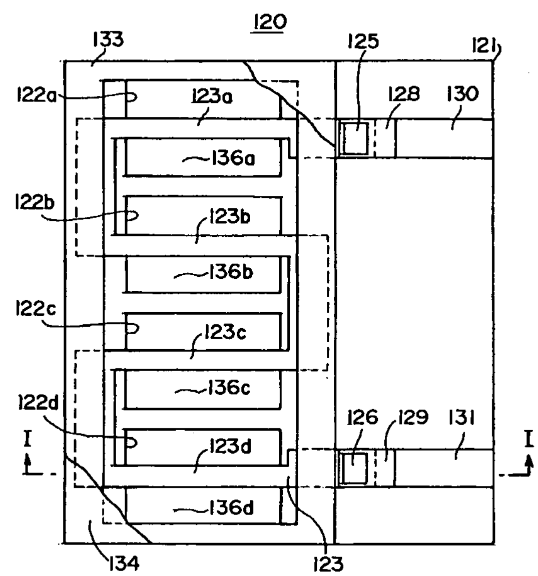

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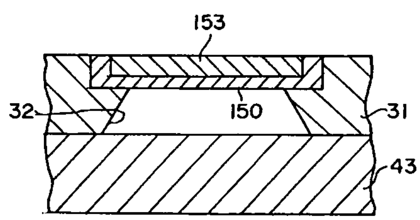

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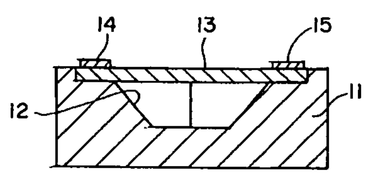

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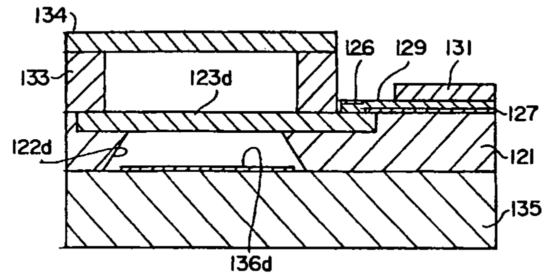
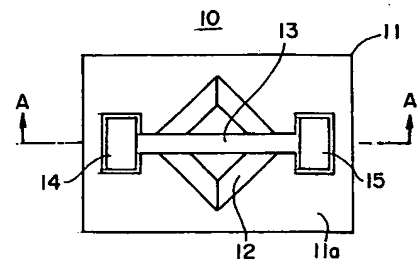
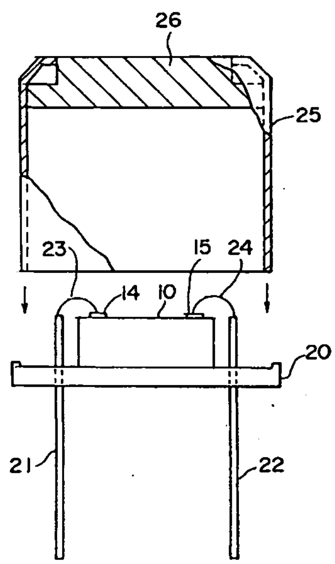

134
133
123d
126
129
131
127
122d
121
135
136d

【図２１】


10
13
11
A
A
14
15
12
11a

【図２３】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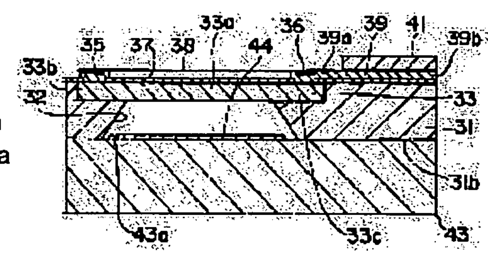
(72)Inventor : KOTADO SETSUO

(54) INFRARED EMITTING ELEMENT

(57)Abstract:
PROBLEM TO BE SOLVED: To mount an element on a circuit by a single piece for reducing the cost.
SOLUTION: An infrared emitting element is provided with an element substrate 31, having a hole 32 which passes through the substrate from one face to an opposite face, a p-type semiconductor layer 33 which is formed on one face of the substrate 31 and has a bridge-like heating section 33a stretched over the opening face of the hole 32 and emits infrared rays from the heating section 33a, when it is supplied with power, a pair of electrodes 35, 36 formed on the p-type semiconductor layer 33 for supplying power to the heating section 33a, a pair of terminals 41 for supplying power which are formed on an end part of one face of the substrate 31 and the connected to the electrodes 35, 36 respectively, and a reinforcing substrate 43 fixed on the opposite face of the substrate to reinforce the substrate. Due to this structure, the entire element is reinforced by the reinforcing substrate 43. Moreover, since the terminals 41 are formed on an end part of one face of the element substrate 31, the element can be easily assembled into a circuit or an equipment as a single piece.



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CLAIMS

[Claim(s)]

[Claim 1] The component substrate which has the concavity which caves in to an opposite side side from a hole [which is penetrated from a whole surface side to an opposite side], or whole surface side, The semi-conductor layer to which it is formed in said whole surface side of said component substrate, have the exoergic section of the shape of a bridge which crosses the effective area of said hole or a concavity, and infrared radiation is made to emit from said exoergic section by energization, The electrode of the pair formed on said semi-conductor layer in order to energize in said exoergic section, The infrared emission component equipped with the terminal of the pair for electric power supplies which was formed in the edge at said whole surface side of said component substrate, and was connected to the electrode of said pair, respectively, and the reinforcement substrate fixed to said opposite side of said component substrate for component reinforcement.

[Claim 2] The infrared emission component according to claim 1 characterized by having the frame-like object which has the insulation formed so that said exoergic section might be surrounded by said whole surface side of said component substrate, and covering which has infrared permeability and has the insulation formed so that the effective area of said frame-like object might be covered.

[Claim 3] The infrared emission component according to claim 1 or 2 characterized by being formed as the part by the side of the whole surface of said reinforcement substrate which has plugged up said hole of said component substrate at least, or the bottom of the concavity of said component substrate shows a high reflection factor to infrared radiation.

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the technique for simplifying structure, raising productivity and lowering cost in the infrared emission component which emits infrared radiation from the exoergic section formed with the semi-conductor on component substrates, such as silicon.

[0002]

[Description of the Prior Art] The infrared emission component is used also as the light source of the gas-analysis device using the infrared absorption other than the use as a light emitting device.

[0003] Although the filament of the thing, platinum, and the tungsten which embedded the heater to the ceramic was enclosed with the glass tube, since heat capacity is large, when anything of structure has the problem that aging is large, and making infrared radiation emit intermittently (chopping), the high-speed mechanical chopper was required for the infrared light source used from the former for this infrared type gas analysis separately.

[0004] In order to solve this problem, the so-called infrared emission component of the microbridge structure of preparing the exoergic section which uses a micro-machining technique and becomes the whole surface of component substrates, such as silicon, from a semi-conductor, energizing in this exoergic section, and emitting infrared radiation is proposed variously.

[0005] As an infrared emission component of this microbridge structure, the thing of the structure shown in drawing 21 and drawing 22 is known.

[0006] With the micro-machining technique, this infrared emission component 10 formed the concavity 12 in the whole surface 11a side of the component substrate 11 of silicon, it formed the exoergic section 13 which consists of a p type semiconductor so that the effective area of this concavity 12 might be crossed, and it has formed electrodes 14 and 15 in the both ends of the exoergic section 13.

[0007] With this infrared emission component 10, if an electrical potential difference is impressed between an electrode 14 and 15, the exoergic section 13 will generate heat and infrared radiation will be emitted.

[0008] Since [that a component configuration is small] such an infrared radiating element 10 of microbridge structure has small heat capacity, it has the advantage that high-speed chopping is made.

[0009] Since it is inconvenient to mount in various equipments in the form of this as, the infrared emission component 10 formed in component substrate top 11 of silicon however, in fact As shown in drawing 23 , the infrared emission component 10 is mounted on the case substrate 20. After connecting between the upper limit of the lead terminals 21 and 22 fixed so that the case substrate 20 might be penetrated, and the electrodes 14 and 15 of the infrared radiating element 10 with the golden wires 23 and 24, respectively (bonding) While putting the cylinder case 25 and protecting the infrared emission component 10, it enables it to supply a power source from terminals 21 and 22.

[0010] In addition, the top face of the cylinder case 25 is covered with the aperture 26 which consists of the quality of the material (for example, sapphire) with high permeability to infrared radiation, and the infrared radiation emitted from the infrared emission component 10 is emitted to the exterior from this aperture 26.

[0011]

[Problem(s) to be Solved by the Invention] However, as described above, the infrared emission component 10 was mounted on the case substrate 20, wiring between the electrodes 14 and 15 and lead terminals 21 and 22 was performed, and since the components mark of the infrared emission machine which puts the cylinder case 25 and is completed other than the production process of the component itself increased including processes, such as mounting, bonding, and case immobilization, it had the problem of becoming cost quantity.

[0012] This invention solves this problem, can mount it in a circuit with a component item, and aims at offering the infrared emission component which realized low cost-ization.

[0013]

[Means for Solving the Problem] In order to attain said purpose, the infrared emission component of claim 1 of this invention The component substrate which has the concavity which caves in to an opposite side side from a hole [which is penetrated from a whole surface side to an opposite side], or whole surface side, The semi-conductor layer to which it is formed in said whole surface side of said component substrate, have the exoergic section of the shape of a bridge which crosses the effective area of said hole or a concavity, and infrared radiation is made to emit from said exoergic section by energization, The electrode of the pair formed on said semi-conductor layer in order to energize in said exoergic section, It was formed in the edge at said whole surface side of said component substrate, and has the terminal of the pair for electric power supplies connected to the electrode of said pair, respectively, and the reinforcement substrate fixed to said opposite side of said component substrate for component reinforcement.

[0014] Moreover, the infrared emission component of claim 2 of this invention is equipped with the frame-like object which has the insulation formed so that said exoergic section might be surrounded by said whole surface side of said component substrate, and covering which has infrared permeability and has the insulation formed so that the effective area of said frame-like object might be covered in the infrared emission component of claim 1.

[0015] Moreover, in the infrared emission component of claim 1 or claim 2, the

infrared emission component of claim 3 of this invention is formed, as the part by the side of the whole surface of said reinforcement substrate which has plugged up said hole of said component substrate at least, or the bottom of the concavity of said component substrate shows a high reflection factor to infrared radiation.

[0016]

[Embodiment of the Invention] Hereafter, the operation gestalt of this invention is explained based on a drawing. In addition, in explanation of each following operation gestalt, the same sign is given to the same component and explanation is omitted.

[0017] Drawing 1 and drawing 2 show the infrared emission component 30 of the 1st operation gestalt of this invention. It is formed about [25mmx10mm] in the shape of an oblong rectangle with n mold silicon, and, as for the component substrate 21 of this infrared emission component 30, the hole 32 penetrated from the whole surface 31a side to trapezoidal shape at the opposite side 31b side is established in that end side.

[0018] The p type semiconductor layer 33 is formed in the whole surface 31a side of the component substrate 31 in the shape of abbreviation h. Exoergic section 33a formed so that the center of the effective area of a hole 32 might be crossed to the whole surface 31a side of the component substrate 31 is prepared in the p type semiconductor layer 33. The electrodes 35 and 36 of a pair which consist of metal material (gold, aluminum, etc.) are formed in the front face of the both ends 33b and 33c of the p type semiconductor layer 33.

[0019] The both ends 33b and 33c of the p type semiconductor layer 33 are broad, and since, as for exoergic section 33a, resistance is highly separated from the component substrate 31 by narrow to moreover resistance being low in contact with the component substrate 31, when an electrical potential difference is impressed between an electrode 35 and 36 and a current is passed in the p type semiconductor layer 33, only exoergic section 33a generates heat and they emit infrared radiation.

[0020] The front face except a part for the joint of whole surface 31a of the component substrate 31 and electrodes 35 and 36, and the p type semiconductor layer 33 is covered with the silicon oxide 37 (it is omitting in drawing 1) for having insulation and promoting radiation of infrared radiation.

[0021] Namely, only in for a surface protection, about 0.1 micrometers of the thickness of an oxide film are enough, but with the infrared emission component 30 of this operation gestalt, since it became clear that infrared emissivity was markedly alike in carrying out thickness of silicon oxide more than constant value (about 1

micrometer), and it became high as shown in drawing 3 The thickness of the silicon oxide 37 of the front face of the exoergic section 33 is set as 0.4 micrometers or more (for example, about 1 micrometer) at least, protection of a front face is strengthened, and infrared radiant efficiency is raised.

[0022] The connection patterns 38 and 39 which consist of metal material (gold, aluminum, etc.) are formed in the front face of silicon oxide 37. The end 38a side was connected to the electrode 35, and, as for one connection pattern 38, the other end 38b side is prolonged in the other end side of the component substrate 31.

[0023] The end 39a was connected to the electrode 36, and, as for the connection pattern 39 of another side, other end 39b is prolonged in the other end side of the component substrate 31.

[0024] The terminals 40 and 41 for electric power supplies are formed in the top face of the other ends 38b and 39b of the connection patterns 38 and 39 with solder etc.

[0025] Terminals 40 and 41 had a predetermined clearance and are prolonged to the shorter side side edge of the component substrate 31 in parallel. Terminal spacing of terminals 40 and 41 is set as about 5.1mm (2/10 inch) or about 7.6mm (3/10 inch) so that the connector of for example, a 1/10 inch pitch can be equipped.

[0026] On the other hand, the reinforcement substrate 43 which has the insulation of the same appearance as the component substrate 31 for component reinforcement is being fixed to the opposite side 31b side of the component substrate 31. Heat conduction consists of the good quality of the material like an alumina or sapphire, and this reinforcement substrate 43 has the thickness of 200 micrometers - 500 micrometers, in order that treating the thickness of the infrared emission component 30 whole with a component item may make it 0.5mm - about 1 easymm.

[0027] The reflective film 44 (for example, a golden thin film, aluminum foil, etc.) which has a high reflection factor to infrared radiation is formed in the part which forms the bottom of the hole 32 of the component substrate 31 among top-face 43a of the reinforcement substrate 43. Since the infrared radiation emitted to the reinforcement substrate 43 side from exoergic section 33a is reflected in the whole surface side of the component substrate 31 with this reflective film 44, infrared radiant efficiency becomes high.

[0028] This infrared emission component 30 can be easily manufactured with a micro-machining technique. Hereafter, the manufacture approach is explained briefly. In addition, although the following explanation explains one infrared emission

component 30, two or more infrared emission components 30 are formed on a big component substrate in fact at coincidence.

[0029] First, n of field bearing (100) of specific resistance 8 - 15 ohm-cm - The substrate of a mold single crystal semiconductor is prepared as a base material of a component substrate (this base material is hereafter called component substrate 31), and a photo-etching technique removes the thermal oxidation film of the field which forms the thermal oxidation film with a thickness of about 0.7 micrometers, and forms the p type semiconductor layer 33 by performing thermal oxidation processing to the whole surface of that component substrate 31.

[0030] Ion-implantation is used to the whole surface of the component substrate 31. Next, high concentration, For example, they are 4.0x1016 ion / cm2 as a dose. Drive in boron with the acceleration voltage of 175kV, and annealing for 10 to about 60 minutes is performed in a 1100-1200-degree C hot nitrogen-gas-atmosphere mind. After forming the p type semiconductor layer 33 of desired thickness (for example, 5 micrometers) in the field to which said oxide film was removed, the thermal oxidation film of the front face of the component substrate 31 is removed.

[0031] Next, it is the thermal oxidation film 37 (this oxide film 37) at the thickness of 0.4 micrometers - about 1 micrometer by thermal oxidation processing to the whole surface side of the component substrate 31. protection of a component front face and the object for infrared radiation promotion -- it is, after it forms and a photo-etching technique removes the thermal oxidation film of the electrode formation field of the both ends of the p type semiconductor layer 33 After forming thin films, such as gold and aluminum, in the whole whole surface side of the component substrate 31 with a vacuum deposition method, by patterning, thin films other than an electrode formation field and a connection pattern formation field are removed, and electrodes 35 and 36 and the connection patterns 38 and 39 are formed.
 [0032] Next, the hole 32 penetrated from the inferior-surface-of-tongue side of exoergic section 33a to the opposite side side of the component substrate 31 using anisotropic etching properties, such as ammonia liquor, and the carrier concentration dependency of an etch rate is formed.

[0033] Next, the high voltage (about 500V) is impressed between an electrode 35 or an electrode 36, and opposite side 43b of the reinforcement substrate 43, the whole component is heated at 200-300 degrees C, and the opposite side of the component substrate 31 is made to carry out welding of the whole surface 43a of the reinforcement substrate 43, where whole surface 43a of the reinforcement substrate 43 is put on the opposite side of the component substrate 31 in a vacuum.

[0034] And solder is vapor-deposited on the top face of the other ends 38b and 39b of the connection patterns 38 and 39, and terminals 40 and 41 are formed in it.
[0035] Finally, the item of the above mentioned infrared emission component 30 is obtained by dividing a component substrate per chip by the dicer.
[0036] Since the whole component is reinforced by the reinforcement substrate 43 and terminals 40 and 41 are formed in the edge by the side of the whole surface of the component substrate 31, the infrared emission component 30 constituted as mentioned above is easily [a circuit or equipment] incorporable with a component item.
[0037] For example, as shown in drawing 4 , the connector 46 mounted on the circuit board 45 can be equipped with the infrared emission component 30.
[0038] Moreover, the terminals 40 and 41 of the infrared emission component 30 can also be directly soldered on the circuit board 45 like drawing 5 , without using a connector.
[0039] Moreover, as shown in drawing 6 , without equipping directly on the circuit board, it is also possible to solder and use lead wire 47 for the terminals 40 and 41 of the infrared emission component 30.
[0040] Thus, since it is not necessary to mount the infrared emission component 30 of an operation gestalt on a case like a component before and it can be used with a component item, it can reduce a manufacturing cost sharply and can lower product cost sharply.
[0041] Moreover, with this infrared emission component 30, although the terminals 40 and 41 for current supply were formed in the end side of exoergic section 33a in parallel with exoergic section 33a, this does not limit this invention. For example, like drawing 7 and the infrared emission component 50 of drawing 8 , the p type semiconductor layer 33 may be formed in the shape of H (the shape of or U character), electrodes 35 and 36 may be formed in the both ends, and the terminals 40 and 41 for current supply may be formed in the tip side of the connection patterns 38 and 39 prolonged in the sense which intersects perpendicularly with exoergic section 33a from electrodes 35 and 36. In addition, in consideration of wearing to a connector, spacing of terminals 40 and 41 is set up even in this case.
[0042] Moreover, although the front face of exoergic section 33a was protected only by silicon oxide 37, you may make it cover a front face with sapphire etc. with said infrared emission components 30 and 50 like the infrared emission component 60 shown in drawing 9 and drawing 10 .
[0043] The component substrate 61 of this infrared emission component 60 is n. -

With mold silicon, it is formed about [40mmx15mm] in the shape of an oblong rectangle, and the hole 62 penetrated from the whole surface 61a side to trapezoidal shape at the opposite side 61b side is established in that end side.

[0044] The p type semiconductor layer 63 is formed in the whole surface 61a side of the component substrate 61 in the shape of sideways [of U characters]. it was formed in the p type semiconductor layer 63 so that it might return from the tip (it is a left end at drawing 9) of exoergic section 63a which crosses the center of the effective area of a hole 62 to the whole surface 61a side of the component substrate 61, and exoergic section 33a to the other end side of the component substrate 61 along the periphery of a hole 62 -- section 63b is prepared by return. The width of face of this clinch section 63b is set up more greatly than exoergic section 63a so that big generation of heat by energization may not arise.

[0045] If the electrodes 65 and 66 of a pair which consist of metal material are formed in the both-ends front face of the p type semiconductor layer 63 and an electrical potential difference is impressed among electrodes 65 and 66, exoergic section 63a will generate heat and infrared radiation will be emitted.

[0046] The front face from electrodes 65 and 66 to the other end side edge of the component substrate 61 is covered with silicon oxide 67.

[0047] The connection patterns 68 and 69 which consist of metal material are formed in the front face of this silicon oxide 67. The end side was connected to the electrode 65, and, as for one connection pattern 68, the other end side is prolonged in the other end side of the component substrate 61.

[0048] The end was connected to the electrode 66 and, as for the connection pattern 69 of another side, the other end is prolonged in the other end side of the component substrate 61.

[0049] The terminals 70 and 71 for electric power supplies are formed in the top face of the other end of the connection patterns 68 and 69. Terminals 70 and 71 had a predetermined clearance and are prolonged to the edge by the side of the end of the component substrate 61 in parallel. Terminal spacing of terminals 70 and 71 is set as about 5.1mm (2/10 inch), about 7.6 etc.mm (3/10 inch), etc. so that the connector of a 1/10 inch pitch can be equipped at said this appearance.

[0050] The frame-like object 73 formed in the shape of a rectangle frame with silicon, glass, etc. is being fixed to the other end side top face of the component substrate 61 so that exoergic section 63a may be surrounded.

[0051] The top-face side where opening of the frame-like object 73 was carried out is covered with the covering 74 formed in plate-like with sapphire, glass, etc. with

the high transmission to infrared radiation.

[0052] On the other hand, the reinforcement substrate 75 which has the insulation of the same appearance as the component substrate 61 for component reinforcement is being fixed to the opposite side 61b side of the component substrate 61. This reinforcement substrate 75 has the thickness of 200 micrometers - 500 micrometers with the quality of the material with sufficient heat conduction like an alumina or sapphire. The reflective film 76 (for example, a golden thin film, aluminum foil, etc.) which has a high reflection factor to infrared radiation is formed in the part which forms the bottom of the hole 62 of the component substrate 61 among top-face 75a of this reinforcement substrate 75.

[0053] This infrared emission component 60 can also be easily manufactured with a micro-machining technique. Hereafter, the manufacture approach is explained briefly. In addition, although the following explanation explains one infrared emission component 60, two or more infrared emission components 60 are formed on a big component substrate in fact at coincidence.

[0054] First, n of field bearing (100) of specific resistance 8 - 15 ohm-cm - A mold single crystal semiconductor is prepared as a component substrate 61, and a photo-etching technique removes the thermal oxidation film of the field which forms the thermal oxidation film with a thickness of about 0.7 micrometers, and forms a p type semiconductor layer by performing thermal oxidation processing to the whole surface of the component substrate 51.

[0055] Ion-implantation is used to the whole surface of the component substrate 61. Next, high concentration, For example, they are 4.0x1016 ion / cm2 as a dose. Drive in boron with the acceleration voltage of 175kV, and annealing for 10 to about 60 minutes is performed in a 1100-1200-degree C hot nitrogen-gas-atmosphere mind. After forming the p type semiconductor layer 63 of desired thickness (for example, 5 micrometers) in the field to which said oxide film was removed, the thermal oxidation film of the front face of the component substrate 61 is removed.

[0056] Next, silicon oxide 67 is formed in the whole surface side of the component substrate 61 by the thickness of 0.4 micrometers - about 1 micrometer by thermal oxidation processing. After a photo-etching technique removes the thermal oxidation film of an electrode formation field, on the whole whole surface of the component substrate 61 Gold, After forming thin films, such as aluminum, with a vacuum deposition method, by patterning, thin films other than an electrode formation field and a connection pattern formation field are removed, and electrodes 65 and 66 and the connection patterns 68 and 69 are formed.

[0057] Next, the hole 62 penetrated from the inferior-surface-of-tongue side of exoergic section 63a to the opposite side side of the component substrate 61 using anisotropic etching properties, such as ammonia liquor, and the carrier concentration dependency of an etch rate is formed.

[0058] Next, where it put the frame-like object 73 on the predetermined location on the component substrate 61 in the vacuum, it repeated covering 74 on the frame-like object 73 and whole surface 75a of the reinforcement substrate 75 is further put on the opposite side of the component substrate 61 Impress the high voltage between covering 74 and opposite side 85b of the reinforcement substrate 75, and the whole component is heated at 200-300 degrees C. Between the upper limit side of a frame-like object 73 and the inferior surfaces of tongue of covering 74 and between whole surface 75a of the reinforcement substrate 75 and the opposite sides of the component substrate 61 are welded between the inferior-surface-of-tongue sides of a frame-like object 73 the whole surface side of the component substrate 61.

[0059] And finally, solder is vapor-deposited on the top face of the other ends 68b and 69b of the connection patterns 68 and 69, and terminals 70 and 71 are formed in it.

[0060] Thus, the produced infrared radiating element is divided per chip by the dicer, and serves as an item.

[0061] With this infrared emission component 60, since the whole component is reinforced by the reinforcement substrate 75 and terminals 70 and 71 are formed in the edge by the side of the whole surface of the component substrate 61, like above mentioned drawing 4 - drawing 6 , wiring by connector wearing, direct attachment, and lead wire is attained, and it can incorporate easily [a circuit or equipment] with a component item.

[0062] Moreover, since the front-face side of exoergic section 63a is covered with covering 74, there is little degradation by the dirt of the front face of exoergic section 63a etc., and this infrared radiating element 60 is reliable.

[0063] Thus, since it is not necessary to mount on a case like a component before and can be used with a component item, the infrared emission component 60 of an operation gestalt can reduce a manufacturing cost sharply, and the large cost cut of it is attained, maintaining high dependability.

[0064] In addition, although the reinforcement substrate 43 and the infrared radiation emitted to 75 sides are reflected in the whole surface side of the component substrates 31 and 61 with the reflective film 44 and 76 from the exoergic sections

33a and 63a with the above-mentioned infrared emission components 30, 50, and 60, when the reinforcement substrate 43 and 75 the very thing have a high reflection factor to infrared radiation, the reflective film 44 and 76 can be omitted.

[0065] Moreover, as shown in (b) of the (a) and its E-E line sectional view of drawing 11 Form the concave surface section 48 in the whole surface side of the reinforcement substrate 43 (75), or (When the reinforcement substrate itself has a high reflection factor to infrared radiation), By what the reflective film 49 is formed for along with this concave surface section 48 (when the reinforcement substrate itself does not have the high reflection factor to infrared radiation) The infrared radiation emitted to the reinforcement substrate 43 (75) side from exoergic section 33a (63a) can be efficiently reflected in the direction which intersects perpendicularly with the whole surface side of the component substrate 31 (61) with the concave surface section 48 or the reflective film 49.

[0066] Moreover, although said operation gestalt explained the case where holes 32 and 62 were established in the component substrates 31 and 61, it can apply this invention similarly about the infrared emission component with which the concavity is prepared in the component substrate.

[0067] For example, a concavity 82 is formed in component substrate 31' like the infrared emission component 80 shown in drawing 12 and drawing 13 . Even when exoergic section 33a of the p type semiconductor layer 33 is formed so that the effective area of a concavity 82 may be crossed to the whole surface side of component substrate 31' The same effectiveness as said infrared emission component 30 is acquired by connecting electrodes 35 and 36 to terminals 40 and 41 through the connection patterns 38 and 39, and fixing the reinforcement substrate 43 to the inferior-surface-of-tongue side of component substrate 31'.

[0068] Moreover, a concavity 92 is formed in component substrate 61' like the infrared emission component 90 shown, for example in drawing 14 and drawing 15 . Even when exoergic section 63a of the p type semiconductor layer 63 is formed so that the effective area of a concavity 92 may be crossed to the whole surface side of component substrate 61' The same effectiveness as said infrared emission component 60 is acquired in the whole surface side of exoergic section 63a with a frame-like object 73 and covering 74 by fixing the reinforcement substrate 75 to the inferior-surface-of-tongue side of component substrate 61' with a wrap by connecting electrodes 65 and 66 to terminals 70 and 71 through the connection patterns 68 and 69.

[0069] In addition, gas, such as helium with high thermal conductivity and an argon,

is enclosed with the part covered with the frame-like object 73 and covering 74 of said infrared radiating element 60 and the infrared radiating element 90.

[0070] Moreover, when the exoergic sections 33a and 63a are formed like the infrared emission components 80 and 90 so that the effective area of the concavities 82 and 92 of component substrate 31' and 61' may be crossed, infrared radiant efficiency becomes high by forming the reflective film 84 and 94 in which a high reflection factor is shown to infrared radiation in the base of concavities 82 and 92.

[0071] Moreover, others are the same although the points which carry out etching processing of the concavities 82 and 92 differ instead of the manufacture approach of these infrared emission components 80 and 90 carrying out etching processing of the holes 32 and 62 in the manufacture approach of the above mentioned infrared emission components 30 and 60.

[0072] Moreover, although said operation gestalt explained the infrared emission component in case the number of the exoergic sections is one, this invention is applicable also about the infrared emission component which has two or more exoergic sections.

[0073] For example, the holes [two or more (drawing four pieces)] 102a-102d are formed in the component substrates 101, such as silicon, like the infrared emission component 100 shown in drawing 16 and drawing 17 . The exoergic sections 103a-103d which crossed the each holes [102a-102d] effective area in the p type semiconductor layer 103 formed in the whole surface side of the component substrate 101, and were connected to the serial (juxtaposition is sufficient) are formed. Between the terminals 110 and 111 for electric power supplies formed at intervals of predetermined is connected to the edge by the side of the whole surface of the electrodes 105 and 106 formed in the both ends of the p type semiconductor layer 103, and the component substrate 101 through the connection patterns 108 and 109.

[0074] And the reinforcement substrate 113 for reinforcement is fixed to the opposite side side of the component substrate 101. In addition, in drawing 16 and drawing 1717 , the silicon oxide which a sign 107 protects the component front face containing each exoergic section 103, and promotes radiation of infrared radiation, and Signs 114a-11d are reflective film which reflects in the whole surface side of the component substrate 101 the infrared radiation emitted to the reinforcement substrate 113 side from each exoergic section 103 with a high reflection factor.

[0075] Moreover, the holes [two or more (drawing four pieces)] 122a-122d are

formed in the component substrates 121, such as silicon, like the infrared emission component 120 shown in drawing 18 and drawing 19 . The exoergic sections 123a-123d which crossed the each holes [122a-122d] effective area in the p type semiconductor layer 123 formed in the whole surface side of the component substrate 121, and were connected to the serial (juxtaposition is sufficient) are formed. The electrodes 125 and 126 formed in the both ends of the p type semiconductor layer 123 are connected to the terminals 130 and 131 formed in the edge by the side of the whole surface of the component substrate 121 at intervals of predetermined through the connection patterns 128 and 129.

[0076] And with a frame-like object 133 and the covering 134 which closes the effective area, an each exoergic sections [123a-123d] front-face side is covered, and the reinforcement substrate 135 for reinforcement is further fixed to the opposite side side of the component substrate 121. In addition, also in this infrared emission component 120, gas, such as helium with high thermal conductivity and an argon, is enclosed with the part covered with a frame-like object 133 and covering 134 as well as said infrared emission components 60 and 90.

[0077] Moreover, it is the reflective film which reflects in the whole surface side of the component substrate 121 the infrared radiation by which a sign 127 is emitted to silicon oxide and Signs 136a-136d are emitted to the reinforcement substrate 135 side from each exoergic sections 123a-123d in drawing 18 and drawing 19 with a high reflection factor.

[0078] Moreover, with said infrared emission components 100 and 120, although every one exoergic section is prepared about one hole, you may form so that two or more exoergic sections may cross the effective area of one hole.

[0079] Thus, infrared emission power per component can be enlarged with the infrared emission component which has two or more exoergic sections.

[0080] Moreover, although the exoergic section was formed by the p type semiconductor layer with each above mentioned infrared emission component In order to reinforce the exoergic section, the bridge supporter 150 which crosses the effective area of a hole 32 (or concavity) with a p type semiconductor is formed in the whole surface side of the component substrate 31 like drawing 20 . The exoergic section 153 is formed with a n-type semiconductor on this bridge supporter 150, power is supplied from the terminal for electric power supplies which is not illustrated in this exoergic section 153, and you may make it make infrared radiation emit. Thus, by forming the exoergic section on a bridge supporter, the reinforcement of the exoergic section can be increased and treatment by the item becomes still

easier.

[0081]

[Effect of the Invention] As explained above, the infrared emission component of claim 1 of this invention is fixing the reinforcement substrate to the opposite side side of a component substrate while connecting the electrode of the exoergic section formed in the shape of a bridge to the terminal for electric power supplies formed in the whole surface side edge section of a component substrate so that a hole or a concavity may be crossed in a semi-conductor layer to the whole surface side of a component substrate.

[0082] For this reason, the process which mounts an infrared emission component in a case anew can become unnecessary, and a connector can be equipped with a component item, or it can solder soon on the circuit board, or can connect with a circuit with wiring of lead wire, a manufacturing cost can be lowered sharply, and an infrared emission component can be offered cheaply.

[0083] Moreover, the infrared emission component of claim 2 of this invention is equipped with the frame-like object which has the insulation formed so that the exoergic section might be surrounded by the whole surface side of a component substrate, and covering which has infrared permeability and has the insulation formed so that the effective area of a frame-like object might be covered.

[0084] For this reason, since the front face of the exoergic section is protected by a frame-like object and covering, there is no degradation by the dirt of an exoergic section front face etc., and dependability becomes high.

[0085] Moreover, since the bottom of the concavity of the reinforcement substrate with which the infrared emission component of claim 3 of this invention has plugged up the hole of a component substrate, or a component substrate is formed so that a high reflection factor may be shown to infrared radiation, infrared radiant efficiency becomes high.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] The top view of 1 operation gestalt of this invention

[Drawing 2] The B-B line sectional view of drawing 1

[Drawing 3] Drawing showing the relation between the thickness of an oxide film, and the rate of infrared emission

[Drawing 4] Drawing showing the example of mounting of the infrared emission

component of an operation gestalt

[Drawing 5] Drawing showing the example of mounting of the infrared emission component of an operation gestalt

[Drawing 6] Drawing showing the example of mounting of the infrared emission component of an operation gestalt

[Drawing 7] The top view of other operation gestalten

[Drawing 8] The C-C line sectional view of drawing 7

[Drawing 9] The top view of other operation gestalten

[Drawing 10] D-D line sectional view of drawing 9

[Drawing 11] The schematic diagram at the time of preparing the concave surface section in a reinforcement substrate

[Drawing 12] The top view of other operation gestalten

[Drawing 13] The F-F line sectional view of drawing 12

[Drawing 14] The top view of other operation gestalten

[Drawing 15] The G-G line sectional view of drawing 14

[Drawing 16] The top view of other operation gestalten

[Drawing 17] The H-H line sectional view of drawing 16

[Drawing 18] The top view of other operation gestalten

[Drawing 19] The I-I line sectional view of drawing 18

[Drawing 20] The schematic diagram showing the example which made the exoergic section two-layer structure

[Drawing 21] The top view of the conventional component

[Drawing 22] The A-A line sectional view of drawing 22

[Drawing 23] Drawing showing sheathing of a component conventionally

[Description of Notations]

30, 50, 60, 80, 90 100 120 Infrared emission component

31 61,101,121 Component substrate

32 62 Hole

33 63,103,123 P type semiconductor layer

33a, 63a, 103a, 123a Exoergic section

35, 36, 65, 66,105,106,125,126 Electrode

38, 39, 68, 69,108,109,128,129 Connection pattern

40, 41, 70, 71,110,111,130,131 Terminal

43 75,113,135 Reinforcement substrate

44 76,114,136 Reflective film

82 92 Concavity